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Lower-Middle Devonian Conodont Biostratigraphy and Palaeoecology, Niagara Peninsula, Ontario

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Abstract

Conodonts recovered from the Lower–Middle Devonian Bois Blanc Formation and Middle Devonian Edgecliff Member of the Onondaga Formation of southern Ontario demonstrate that the conodont fauna is uniform and of low diversity, containing the form genera *Icriodus*, *Belodella*, *Coelocerodontus*, and *Panderodus*. *Acodina*, although possibly a component element of the apparatus of species of *Icriodus*, is rare. Two anomalous samples from the lower part of the Bois Blanc contain elements of a species of *Ozarkodina*. The conodont faunas suggest diachroneity of the Bois Blanc Formation and the unit may transgress the Lower–Middle Devonian boundary. The cherty, bioclastic limestones of the Bois Blanc Formation and Edgecliff Member were deposited on a broad shelf separating the Appalachian and Michigan basins. Very shallow water conditions are indicated by the macrofauna of profuse, colonial corals, and by development of biohermal or reefoid bodies. The conodont fauna therefore is part of a shallow-water community, equivalent perhaps to Druce's Biofacies I or II. *Icriodus* is virtually ubiquitous but *Belodella* and *Coelocerodontus* show heterogeneities in distribution that possibly reflect variations in local environmental conditions, e.g., proximity to reefs. The absence of *Polygnathus* may confirm already proposed ecologic models of conodont distribution in which this genus is placed in a different biofacies than is *Icriodus*.

Introduction

This study developed initially from the recovery by von Bitter of abundant icriodid conodont elements from silicified carbonates collected at Hagersville, Ontario (Fig. 1, loc. 5). It progressed further as a result of regional mapping by Telford and Tarrant for the Ontario Division of Mines, involving strata of Late Silurian and Devonian age, in the Niagara Peninsula of southern Ontario (Fig. 1). Principal objectives of the mapping were precise definition of the Bois Blanc Formation, correlation of overlying carbonate units with either the Onondaga Formation of the Appalachian Basin or the Amherstburg Formation of the Michigan Basin, and assessment of the magnitude of the supposed disconformity between the Bois Blanc and overlying units (Fig. 2). This field mapping led Tarrant to study the distribution of conodonts at locality 2 in greater detail (Tarrant, 1975).

Best (1953) and Hewitt (1972) included all Devonian strata of the Niagara Peninsula in the Bois Blanc Formation. Oliver (1967) limited the Bois Blanc to the lower part of the Devonian sequence and suggested correlation of the overlying strata with the Onondaga Formation. Sanford (1969) also used a restricted definition of the Bois Blanc but equated the overlying strata with the Amherstburg Formation. Recent mapping (Telford and Tarrant, 1975a, 1975b) has confirmed the restricted definition of the Bois Blanc, and supports Oliver's recognition of the Onondaga in the Niagara Peninsula. The lower 3–10 metres of the Onondaga in this area have been designated on lithological grounds as the Edgecliff Member as defined by Oliver (1954).

Materials and Methods

Sixty-eight samples were taken from the Bois Blanc Formation and Edgecliff Member at six localities in the Niagara Peninsula (Fig. 2). Reconnaissance samples were also obtained from the basal Bois Blanc from locality 7 at Innerkip and localities 8 and 9 along

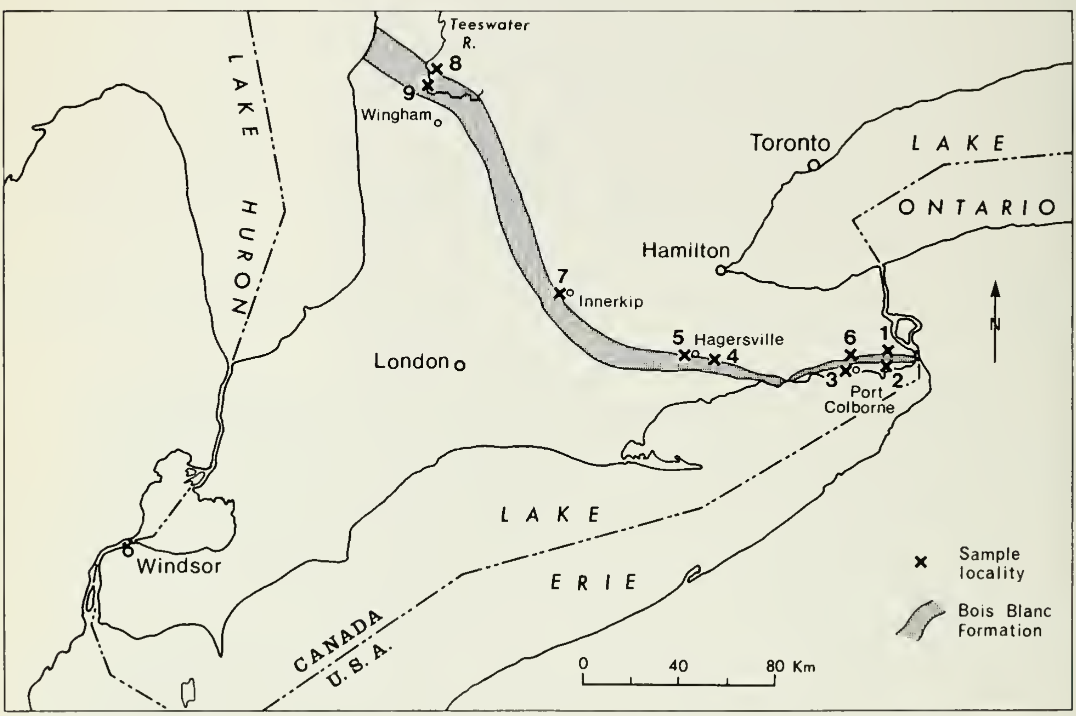

Fig. 1 Conodont sample localities and surface outcrop distribution of Bois Blanc Formation, southwestern Ontario.

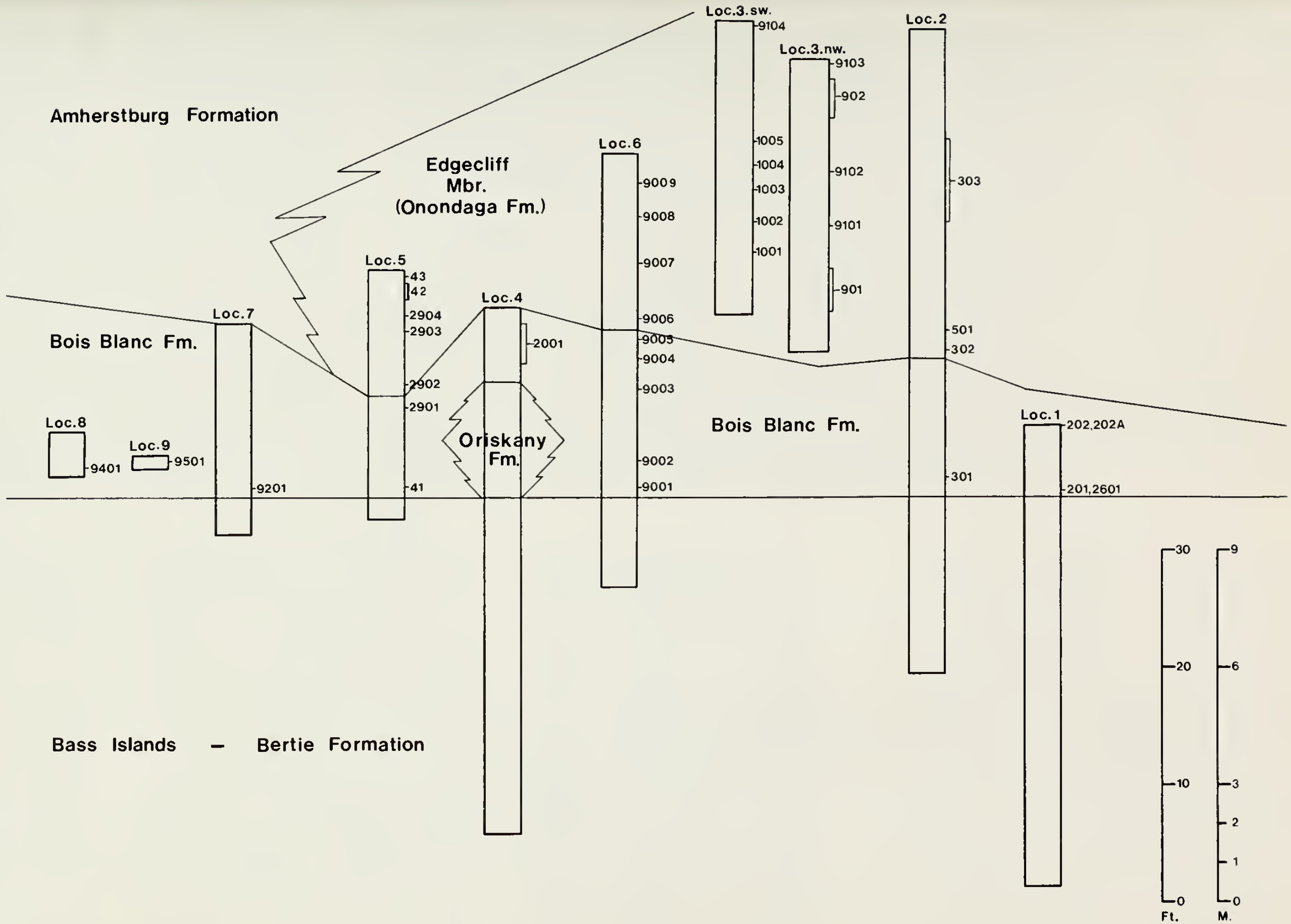

Fig. 2 Stratigraphic location of samples collected for conodonts at localities 1 to 9. All samples processed were approximately 2.0 kg in size.

the Teeswater River, north of Wingham. The samples represent three very different palaeogeographic regions. The Niagara Peninsula samples are from strata laid down in the Appalachian Basin; the Innerkip material is from strata deposited on the shelf formed by the Algonquin Arch; and the Teeswater River samples are from sediments deposited in the Michigan Basin.

Sample localities and positions are indicated on Figs. 1, 2, and 3 and described in the Appendix. Conodont specimens used in this study are housed in the micropalaeontological collections of the Department of Invertebrate Palaeontology, Royal Ontario Museum. They bear the numbers ROM 35471 to ROM 35649 and are available for study.

Composition of Conodont Faunas

Conodonts occurred in varying abundances, ranging from zero to several hundred per two kg sample. Microfaunal associates of the conodonts in some samples are acrotretid brachiopods, ostracods, fish teeth and plates, gastropods, and tentaculitids. The conodont faunas (Tables 1 and 2) are of remarkably low diversity, and generally consist of species of *Icriodus, Belodella, Coelocerodontus*, and *Panderodus; Acodina* is a rare constituent.

Elements of a species of *Ozarkodina* were recovered from only two samples, i.e., at localities 1 and 2 from the Bois Blanc Formation. The apparatus of this species, probably incomplete, includes Sp, Oz, Syn, Pl, and Hi elements. The Sp element is comparable to the form species *Spathognathodus remscheidensis* Ziegler, but because of the high degree of morphological variability in this group (Bultynck, 1971; Telford, 1975) it is not possible to determine the specific identity of the six platform elements in our collections.

Several taxonomic problems were encountered in the identification of elements present in these faunas. It is not the intention of this paper to consider these problems in detail but it is necessary to mention them to clarify the meaning of certain assigned names and to explore possible multi-element arrangements.

The simple cones can be separated into four groups as follows:

a) *Acodina* spp.
b) *Belodella* spp.
c) *Coelocerodontus* sp.–*Panderodus valgus* (Philip)
d) *Panderodus simplex* (Branson and Mehl)

Acodina spp. are uncommon, occurring in low numbers in only a few samples (Tables 1 and 2). Previous workers (Klapper and Philip, 1972) have included such forms in multi-element apparatuses with icriodiform platform elements, but the marked disparity in numbers of icriodiform and acodiniform elements is a problem. This situation parallels a similar under-representation of ramiform elements observed in Pennsylvanian conodont faunas (von Bitter, 1972, 1976).

Species of groups b, c, and d are each considered to represent multi-element apparatuses. Group b contains the form species *Belodella resima* (Philip) and *B. triangularis* (Stauffer). The former is characterized by a flattened triangular cross-section and the latter by a symmetrical broadly triangular cross-section. However, gradational forms are common. Distribution of the belodelliform elements appears independent of the other simple cones, including the coelocerodontiform elements with which they have often been grouped (e.g., Klapper and Philip, 1972).

Coelocerodontus sp., a bilaterally symmetrical form, and *Panderodus valgus*, which is asymmetrical, are closely associated in the faunas and appear to constitute a symmetry transition series. They are similar morphologically in being very thin-walled with deep basal cavities. Rare specimens of both form species have partly denticulated keels at their anterolateral margins.

Panderodus simplex is less common than the other simple cones (Tables 1 and 2) and differs from them in having thicker walls and lacking denticles and keels. The distribution of *Panderodus simplex* is independent of the *Coelocerodontus* sp.–*Panderodus valgus* group.

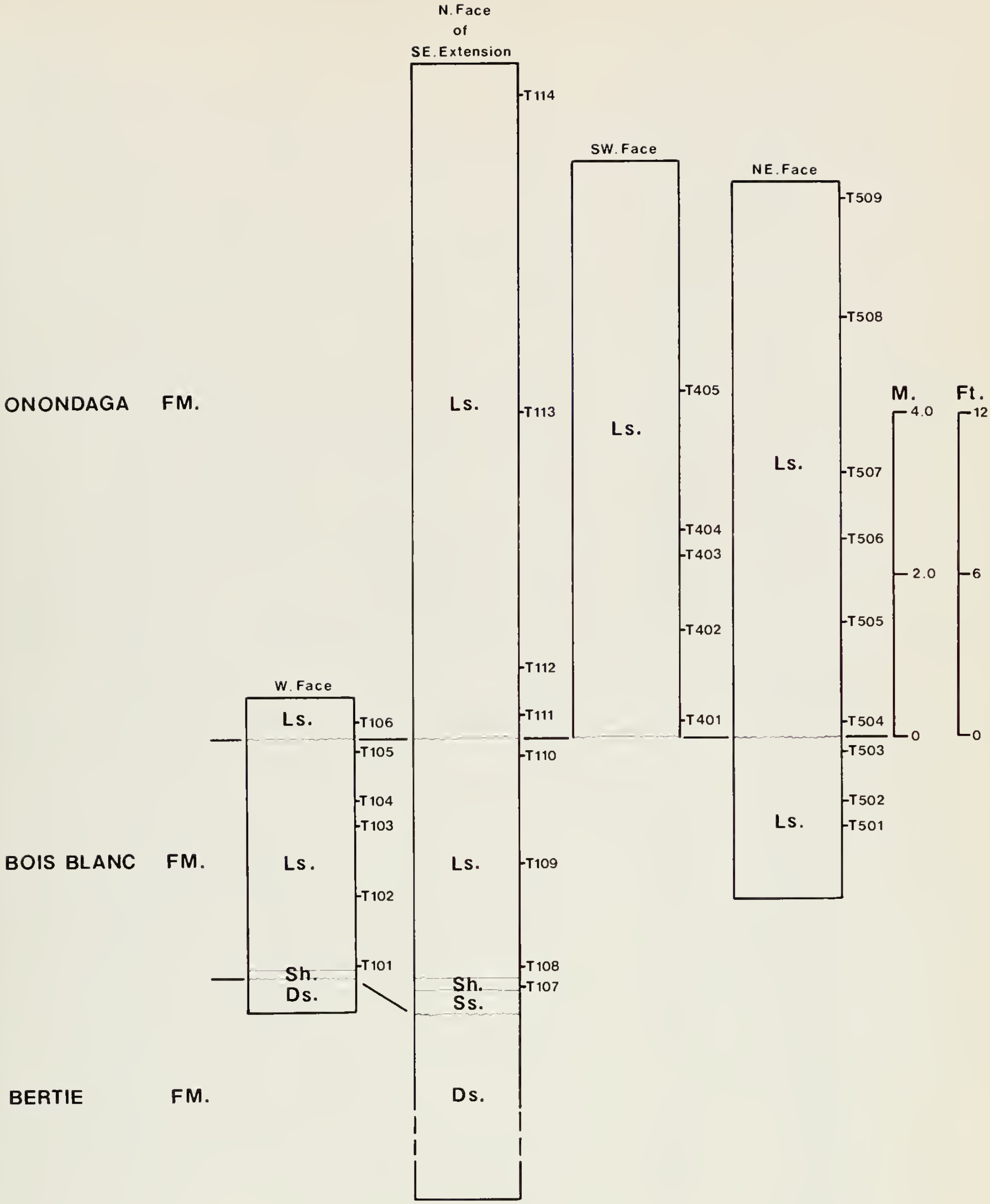

Fig. 3 Stratigraphic location of samples collected from four quarry faces at locality 2. Ls. = limestone; Ds. = dolostone; Ss. = sandstone; Sh. = shale. Detailed information regarding sample sites, sampling methods, and lithologic descriptions may be obtained from Tarrant (1975).

Table 1. **Conodonts recovered from the Bois Blanc Formation and Edgecliff Member (Onondaga Formation) at localities 1 to 9. Only samples which have yielded conodonts are tabulated.**

Bois Blanc Formation											
Sample Code	9501	9401	9201	41	9004	2901	2601	2001	301	202A	202
Icriodus latericrescens robustus Orr											
Simple	-	6	14	-	2	-	-	13	-	-	-
Intermediate	2	7	59	5	12	2	1	1	-	-	-
Advanced	-	11	39	4	11	-	-	-	-	-	-
Fragmentary	-	50	11	11	34	-	2	23	3	4	1
Acodina sp.	-	6	9	1	-	-	1	9	-	2	-
Belodella spp.	-	-	26	-	3	-	-	11	-	-	-
Panderodus simplex	-	38	17	4	1	-	-	12	4	2	-
Panderodus valgus	-	-	-	-	-	-	-	12	-	-	-
Coelocerodontus sp.	-	-	-	-	-	-	-	21	1	-	-
Ozarkodina sp.											
Sp element	-	-	-	-	-	-	-	-	-	-	4
Hi element	-	-	-	-	-	-	-	-	-	-	2
Oz element	-	-	-	-	-	-	-	-	-	-	1
Syn element	-	-	-	-	-	-	-	-	-	-	1
Total Specimens	2	118	175	25	63	2	4	102	8	8	9

Edgecliff Member (Onondaga Formation)																			
Sample Code	42	43	9009	9008	9006	2904	2903	2902	1005	1004	1003	1002	1001	901	9102	902	501	303	302
Icriodus latericrescens robustus Orr																			
Simple	3	1	3	2	-	-	-	-	1	1	2	6	-	-	1	1	1	-	13
Intermediate	13	6	4	5	-	2	4	-	9	-	2	15	-	-	1	2	8	1	34
Advanced	4	2	2	2	-	-	-	-	1	1	1	1	-	-	-	-	7	-	3
Fragmentary	13	12	3	3	4	1	2	-	7	1	1	17	-	-	1	-	1	-	28
Acodina sp.	1	2	1	-	-	-	-	-	-	2	2	9	-	1	1	1	-	-	-
Belodella spp.	2	33	38	40	1	-	-	-	26	132	142	96	4	-	111	28	79	29	131
Panderodus simplex	1	5	1	14	1	-	-	2	5	6	2	15	-	-	3	1	10	7	3
Panderodus valgus	4	1	-	3	-	-	-	-	3	3	14	8	-	-	-	2	-	1	20
Coelocerodontus sp.	15	2	-	-	-	7	20	6	4	20	-	4	-	-	3	6	-	2	9
Ozarkodina sp.																			
Sp element	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hi element	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oz element	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syn element	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Specimens	56	64	52	69	6	10	26	8	56	166	166	171	4	1	121	41	106	40	241

Table 2. **Conodonts recovered from detailed sampling of the Bois Blanc Formation and Edgecliff Member (Onondaga Formation) of four sections at locality 2. Only samples which yielded conodonts have been tabulated. For further information regarding sample sites refer to Fig. 3 and to Tarrant (1975).**

	Bois Blanc Formation							Edgecliff Member (Onondaga Formation)															
Sample Code	T101	T102	T103	T107	T108	T110	T503	T106	T111	T112	T113	T114	T401	T402	T403	T404	T405	T504	T505	T506	T507	T508	T509
Icriodus latericrescens																							
robustus Orr	1	3	2	-	1	14	163	6	49	2	4	2	39	5	8	-	-	-	5	1	1	5	1
Acodina sp.	-	-	-	-	-	-	4	-	1	-	-	-	-	-	-	-	-	-	-	-	1	2	-
Belodella spp.	1	-	-	-	-	-	4	11	219	10	69	30	76	57	68	39	11	6	347	188	27	196	74
Panderodus valgus	-	-	-	-	-	-	15	-	-	-	-	-	-	2	1	-	-	-	-	-	1	5	-
Panderodus sp.	-	-	-	3	1	-	5	-	-	4	-	1	-	-	1	-	3	-	-	-	-	-	-
Coelocerodontus sp.	-	-	1	1	-	-	286	3	25	-	15	2	2	7	6	-	-	2	14	7	3	26	22
Ozarkodina sp.																							
Sp element	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hi element	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oz element	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syn element	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pl element	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Specimens	2	3	3	4	9	14	477	20	294	16	88	35	117	71	84	39	14	8	366	196	33	234	97

Icriodiform conodonts, essentially the only platform elements in the faunas, were thought initially to represent several species. However, morphological transitions observed in specimens in several samples, as for example in sample C9201, suggest that all the icriodiform elements are referable to the subspecies, *Icriodus latericrescens robustus* Orr. Specimens range from very small elements with no lateral processes (superficially similar to *I. angustus* Stewart and Sweet, as illustrated in Klapper and Ziegler, 1967, pl. 10, figs. 1-3), through slightly larger elements with one incipient lateral process, to elements with one well-developed lateral process (identical with *I. latericrescens robustus* of Orr, 1971, pl. 2, figs. 14-15), and finally to large elements with an expanded posterior area containing a large denticulated lateral process opposite a prominent but shorter nondenticulated lateral process. The end member of this gradational series resembles *I. latericrescens bilatericrescens* Ziegler. In Table 1 the elements lacking processes are referred to as "simple"; those with one process are termed "intermediate"; and those with two processes are termed "advanced". Numerous broken specimens that could be identified to subspecific level by features other than the processes, e.g., denticulation, are placed in the category "fragmentary". Specimens of *I. latericrescens robustus* studied by Tarrant have not been subdivided in this manner (Table 2).

A further morphological variation occurs between specimens of *I. latericrescens robustus* from the Niagara Peninsula and those from the Innerkip and Teeswater River regions. The former are relatively long units with a parallel-sided platform tapering abruptly at the anterior end. Specimens from Innerkip and the Teeswater River localities have shorter, more gradually tapering platforms with fewer denticles. These differences probably reflect geographic variations.

Biostratigraphy

Distribution of the conodont faunas appears to be governed by environmental factors so that local biostratigraphic significance of the faunas is limited. However, further detailed sampling may substantiate distributional patterns that are here interpreted as potentially useful. For example, in the Niagara Peninsula few samples of the Bois Blanc Formation contain "advanced" forms of *Icriodus latericrescens robustus*, while they are abundant in the overlying Edgecliff Member. Farther west (Innerkip, Teeswater River) the "advanced" forms are common in the Bois Blanc. At Innerkip in particular the "advanced" forms are common in the basal bed of the formation. If the occurrences in the Niagara Peninsula are an accurate representation of the fauna, then the Bois Blanc is a markedly diachronous rock unit. Also, the distribution of *I. latericrescens robustus* could be used to define the Bois Blanc in the Niagara Peninsula, particularly where only subsurface material is available and diagnostic lithological characteristics cannot be examined.

We believe that the irregularities in distribution of the simple cones are attributable to environmental factors. Except in one sample, T503 from locality 2, the *Coelocerodontus* sp.–*Panderodus valgus* group is rare in the Bois Blanc Formation. Further sampling is required to determine if this restriction is constant.

Orr (1971) proposed a biostratigraphic zonation using conodont faunas of Early and Middle Devonian age of the Michigan Basin. The conodont faunas from southern Ontario can be correlated with his *Icriodus latericrescens robustus* zone which ranges in age from late Early to early Middle Devonian. This, together with the probable diachronous nature of the Bois Blanc Formation, suggests that this is a lithostratigraphic unit that may transgress the Lower–Middle Devonian boundary.

Direct intercontinental correlation is impossible not only because of the low diversity of the conodont faunas, but more importantly because of the complete absence of platform elements other than *Icriodus latericrescens robustus* and very rare specimens of *Spathognathodus*. *I. latericrescens robustus* is not known from outside eastern North America.

Palaeoecology

The possible environmental effect on distribution of the conodonts from the Niagara Peninsula was tested by grouping the samples according to abundance of icriodiform elements versus abundance of simple cones (excluding *Acodina*). Three groups were established:

a) samples containing a markedly higher proportion of icriodids;
b) samples containing a markedly higher proportion of simple cones;
c) samples in which the numbers of both types are approximately equal.

Generally, the first two groups correspond to particular lithologies or depositional environments, and it is possible to speculate upon the controlling factors of the conodont distribution.

Most samples from the Bois Blanc Formation contain a higher proportion of icriodids than of simple cones. The Bois Blanc is a thin, transgressive limestone unit, presumably representing relatively high energy, shallow water, nearshore conditions. The limestones are laminated, thinly or irregularly bedded, and contain abundant chert (as nodules or thin beds) and varying amounts of terrigenous clastic material. The lower metre of the formation is often composed of glauconitic quartz sandstone. The megafauna includes brachiopods, trilobites, crinoids, corals, and gastropods (Oliver, 1967). During deposition of the formation factors such as rate of sedimentation, supply of terrigenous sediments, wave and current action, and salinity would have been variable. The greater proportion of icriodids in the Bois Blanc may be due to either a preference or tolerance for such variable and seemingly stringent conditions, or may be the result of sorting by high energy processes that caused the more delicate simple cones to be broken up and removed.

Simple cones form the greatest proportion of the conodont faunas in biostromal and biohermal facies of the Edgecliff Member. These facies contain richly fossiliferous (mainly corals and crinoids), cherty, bioclastic limestones which lack the terrigenous clastic component exhibited by the underlying Bois Blanc. Shallow water conditions again are indicated but the more uniform bedding, composition, and megafauna suggest a more stable environment than was present during deposition of the Bois Blanc. Small coralline patch reefs and coral-crinoid mounds up to 100 metres in diameter are common (Telford and Tarrant, 1975b). Within the mounds and close to or within the reefs, simple cones are 25 to 50 times more abundant than are icriodids. Sample T505 (Table 2) was taken from a small coral mound and demonstrates the dominance of simple cones in this lithology. Away from the reefs and mounds, in more regularly bedded though still richly coralline biostromal limestones, icriodids are abundant.

Difference in water depth may be one of several factors involved in producing this distribution pattern, i.e., conodontophorids bearing only simple cones inhabited the shoal areas while those bearing icriodids flourished only in slightly deeper water between the reefs and mounds. This interpretation generally corresponds to the conodont palaeoecological models of Seddon and Sweet (1971) and Druce (1973) which are based primarily on depth stratification of conodont faunas. Druce (1973) described a series of biofacies, representing shallow to deeper water environments, that are characterized by particular conodont taxa or combinations of taxa. His shallowest water facies (Biofacies I) of the Lower Devonian contains only simple cones. Biofacies II (slightly deeper water) also contains some simple cones but is typified by the abundance of platform conodonts such as *Icriodus*.

The Edgecliff Member of the Niagara Peninsula therefore contains conodonts of both Biofacies I and II; however, Biofacies I is uncommon and seems to be dependent on the presence of reefs and biohermal mounds, thus indicating that environmental factors additional to water depth exerted strong controls over conodont distributions. The specialized nature of the reef environment and the differences in nutrient supply, wave energy, and substratum character between reef and inter-reef areas were probably more

effective in separating the conodont biofacies than water depth. Actually, the differences in water depth during deposition of different lithofacies of the Edgecliff Member were small, as indicated by the less than 10 metres of relief exhibited by the biohermal and reefoid structures (Telford and Tarrant, 1975b).

Absence of *Polygnathus*

Species of *Polygnathus* are well represented in upper Lower Devonian sequences of Europe (Ziegler, 1971), western North America (Klapper et al., 1971), and eastern Australia (Telford, 1975), and they form the basis for intercontinental correlation between stratigraphic units of these regions. It is unusual for *Polygnathus* to be absent as is the case in strata of Early Devonian age in the Appalachian and Michigan basins (Klapper et al., 1971). Polygnathids are normally abundant in Middle Devonian marine strata but they are absent from the lower Middle Devonian Edgecliff Member of New York State (Klapper et al., 1971) and Ontario (this study).

In the central New York portion of the Appalachian Basin polygnathids make their first appearance in the Nedrow Member of the Onondaga Formation (Klapper, 1971). In the Niagara Peninsula of Ontario, strata determined to be lithostratigraphically equivalent (Oliver, 1967) to the Nedrow Member (upper Edgecliff and Clarence members of Telford and Tarrant, 1975b) have icriodids as the sole platform elements. The relatively late appearance of polygnathids in the Appalachian Basin is possibly the result of major palaeogeographic barriers. However, the difference in occurrence of polygnathids between central New York and Ontario can also be attributed to local environmental controls. The Nedrow Member consists mainly of thin-bedded, argillaceous limestone (Oliver, 1954) that represents deeper water, nonreef deposition, and more stable conditions than do the biostromal or biohermal limestones of other members of the Onondaga Formation. Davis (1975) noted a similarly controlled distribution of icriodid and polygnathid conodonts in the upper Middle Devonian Tully Limestone of central New York.

Acknowledgments

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Appendix

Locality information and stratigraphic descriptions of localities 1 to 9. Sample codes are indicated after measurements (e.g., 202, 202A, etc.)

LOCALITY 1

Quarry (north face) of George C. Campbell Company Limited. Lot 8, conc. VIII, Bertie Township. 0–10.2 metres, Bertie Formation; 10.2–12.1 metres, Bois Blanc Formation.

0–3.8 m:	medium bedded, brown dolostone with bituminous laminations.
3.8–6.5	medium bedded, grey, argillaceous dolostone.
6.5–8.0	thin or irregularly bedded, grey-brown, finely crystalline dolostone.
8.0–10.2	thin or irregularly bedded, mottled grey and cream, very finely crystalline dolostone.
10.2–10.3	grey shale.
10.3–12.1	medium bedded, cherty, very fossiliferous, bioclastic limestone; conodont samples at 10.3–10.5 (201, 2601) and 11.8–12.1 (202, 202A).

LOCALITY 2

Quarry (east face) of Ridgemount Quarries Limited. Lot 3, conc. VIII, Bertie Township. 0–4.6 metres, Bertie Formation; 4.6–8.2 metres, Bois Blanc Formation; 8.2–16.6 metres, Edgecliff Member of Onondaga Formation.

0–4.6 m:	thin or irregularly bedded, mottled grey-brown and cream, very finely crystalline dolostone.
4.6–4.9	greenish, glauconitic sandstone.
4.9–5.1	grey shale.
5.1–8.2	irregularly bedded, cherty, fossiliferous, partly argillaceous limestone; conodont sample at 5.2–5.4 (301).
8.2–8.9	coarse-grained, crinoidal bioclastic limestone; conodont samples at 8.2–8.3 (302) and 8.6–8.9 (501).
8.9–16.6	irregularly bedded, cherty, coralline bioclastic limestone; conodont sample at 11.1–13.2 (303).

LOCALITY 3

Abandoned quarry (northwest and southwest faces). Lot 6, conc. I, Wainfleet Township.

Northwest face: 0–7.4 metres, Edgecliff Member of Onondaga Formation.

0–2.9 m:	medium bedded, dark grey to black, very fossiliferous, argillaceous limestone; conodont samples at 0.6–1.8 (901) and 2.8–2.9 (9101).
2.9–4.3	massive, coralline limestone.
4.3–7.4	medium bedded, cherty, very fossiliferous, coral-crinoid bioclastic limestone; conodont samples at 4.3–4.5 (9102), 5.8–6.7 (902), and 7.1–7.4 (9103).

Southwest face: 0–7.5 metres, Edgecliff Member of Onondaga Formation.

0–1.2 m:	medium bedded, dark grey to black, very fossiliferous, argillaceous limestone; conodont sample at 0.9–1.2 (1001).
1.2–2.4	medium bedded, crinoidal bioclastic limestone; conodont sample at 1.8–2.0 (1002).
2.4–2.9	medium bedded, brown limestone with shale partings; conodont sample at 2.6–2.8 (1003).
2.9–3.2	grey-brown, uniformly textured, crinoidal bioclastic limestone; conodont sample at 3.1–3.2 (1004).
3.2–7.5	medium bedded, cherty, very fossiliferous, coral-crinoid bioclastic limestone; conodont samples at 3.4–3.5 (1005) and 7.4–7.5 (9104).

LOCALITY 4

Quarry (northwest face) of Cayuga Materials and Construction Company Limited. Lots 45 and 46, conc. I North, North Cayuga

Township. 0–8.8 metres, Bertie Formation; 8.8–11.8 metres, Oriskany Formation; 11.8–13.7 metres, Bois Blanc Formation.

0–1.2 m:	thin to medium bedded, grey, argillaceous dolostone.
1.2–3.5	thin to medium bedded, brown and grey mottled, very finely crystalline dolostone.
3.5–8.8	medium bedded, brown, uniformly textured dolostone with biuminous laminations.
8.8–11.8	massive, grey-white, medium to coarse grained, quartzose sandstone.
11.8–13.7	irregularly bedded, brown to light brown, cherty, weakly fossiliferous, sandy limestone; conodont sample at 12.3–13.2 (2001).

LOCALITY 5

Abandoned quarry (east face). Lots 13 and 14, conc. XIII, Walpole Township. 0–0.5 metres, Bertie Formation; 0.5–2.9 metres, Bois Blanc Formation; 2.9–6.1 metres, Edgecliff Member of Onondaga Formation.

0–0.6 m:	medium bedded, brown, uniformly textured dolostone.
0.6–2.9	irregularly bedded, cherty, very fossiliferous bioclastic limestone with abundant shale partings; conodont samples at 0.8–1.1 (41) and 2.8–2.9 (2901).
2.9–4.7	medium bedded, noncherty, crinoidal bioclastic limestone; conodont samples at 2.9–3.1 (2902) and 4.5–4.7 (2903).
4.7–6.1	medium to thin bedded, cherty, very fossiliferous, coralline limestone; conodont samples at 4.7–4.9 (2904), 4.7–6.1 (42), and 5.8–6.1 (43).

LOCALITY 6

Quarry (west face) of R.E. Law Crushed Stone Limited. Lot 5, conc. II, Humberstone Township. 0–2.2 metres, Bertie Formation; 2.2–6.6 metres, Bois Blanc Formation; 6.6–11.0 metres, Edgecliff Member of Onondaga Formation.

0–2.2 m:	thin or irregularly bedded, mottled grey and cream, very finely crystalline dolostone.
2.2–2.3	grey shale.
2.3–2.9	dark brown, cherty, calcareous sandstone; conodont sample at 2.3–2.9 (9001).
2.9–3.5	medium bedded, grey-green, glauconitic sandstone; conodont sample at 2.9–3.5 (9002).
3.5–5.9	interbedded sandstone and bioclastic limestone with chert nodules; conodont samples at 4.7–5.0 (9003) and 5.6–5.9 (9004).
5.9–6.6	dark brown, cherty limestone with shale partings; conodont sample at 5.9–6.5 (9005).
6.6–8.1	medium bedded, dark grey-brown, noncherty, fossiliferous, argillaceous limestone; conodont sample at 6.6–6.9 (9006).
8.1–9.3	medium bedded, weakly cherty, very fossiliferous limestone with shale partings; conodont samples at 8.1–8.3 (9007) and 8.9–9.3 (9008).
9.3–11.0	irregularly bedded, dark brown, cherty, coralline limestone; conodont sample at 9.8–10.2 (9009).

LOCALITY 7

Abandoned quarry (west face), Innerkip. Lot 9, conc. XVII, East Zorra Township. 0–0.9 metres, Bass Islands Formation, 0.9–5.6 metres, Bois Blanc Formation.

0–0.9 m:	medium bedded, brown, very finely crystalline, weakly laminated dolostone.
0.9–5.6	irregularly bedded, grey-brown, cherty, fossiliferous limestone with shale partings; conodont sample at 0.9–1.5 (9201).

LOCALITY 8

East side of Teeswater River at Pinkerton, about 40 km north of Wingham. Bois Blanc Formation.

0–1.2 m: irregularly bedded, cherty, fossiliferous sandy limestone; conodont sample at 0.6–0.9 (9401).

LOCALITY 9

East side of Teeswater River, 1.5 km southwest of Cargill, about 32 km north of Wingham. Bois Blanc Formation.

0–0.5 m: cherty, fossiliferous, sandy limestone; conodont sample at 0–0.5 (9501).

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